



## General Description

SFGMOS<sup>®</sup> MOSFET is based on Oriental Semiconductor's unique device design to achieve low  $R_{DS(ON)}$ , low gate charge, fast switching and excellent avalanche characteristics. The high  $V_{th}$  series is specially designed to use in motor control systems with driving voltage of more than 10V.

## Features

- Low  $R_{DS(ON)}$  & FOM
- Extremely low switching loss
- Excellent reliability and uniformity
- Fast switching and soft recovery



## Applications

- Switching mode power supply
- Motor driver
- Battery protection
- DC-DC convertor
- Inverters
- UPS

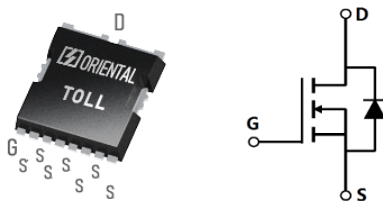
## Key Performance Parameters

| Parameter                         | Value | Unit       |
|-----------------------------------|-------|------------|
| $V_{DS}$                          | 120   | V          |
| $I_D$ , pulse                     | 760   | A          |
| $R_{DS(ON)}$ , max @ $V_{GS}=10V$ | 3.5   | m $\Omega$ |
| $Q_g$                             | 146.6 | nC         |

## Marking Information

| Product Name | Package | Marking    |
|--------------|---------|------------|
| SFG12R03TNF  | TOLL    | SFG12R03TN |

## Package & Pin information



**Absolute Maximum Ratings** at  $T_j=25^{\circ}\text{C}$  unless otherwise noted

| Parameter                                                                 | Symbol                | Value      | Unit               |
|---------------------------------------------------------------------------|-----------------------|------------|--------------------|
| Drain-source voltage                                                      | $V_{DS}$              | 120        | V                  |
| Gate-source voltage                                                       | $V_{GS}$              | $\pm 20$   | V                  |
| Continuous drain current <sup>1)</sup> , $T_C=25^{\circ}\text{C}$         | $I_D$                 | 190        | A                  |
| Pulsed drain current <sup>2)</sup> , $T_C=25^{\circ}\text{C}$             | $I_{D, \text{pulse}}$ | 760        | A                  |
| Continuous diode forward current <sup>1)</sup> , $T_C=25^{\circ}\text{C}$ | $I_S$                 | 190        | A                  |
| Diode pulsed current <sup>2)</sup> , $T_C=25^{\circ}\text{C}$             | $I_{S, \text{pulse}}$ | 760        | A                  |
| Power dissipation <sup>3)</sup> , $T_C=25^{\circ}\text{C}$                | $P_D$                 | 450        | W                  |
| Single pulsed avalanche energy <sup>5)</sup>                              | $E_{AS}$              | 540        | mJ                 |
| Operation and storage temperature                                         | $T_{stg}, T_j$        | -55 to 150 | $^{\circ}\text{C}$ |

**Thermal Characteristics**

| Parameter                                          | Symbol          | Value | Unit                 |
|----------------------------------------------------|-----------------|-------|----------------------|
| Thermal resistance, junction-case                  | $R_{\theta JC}$ | 0.28  | $^{\circ}\text{C/W}$ |
| Thermal resistance, junction-ambient <sup>4)</sup> | $R_{\theta JA}$ | 62    | $^{\circ}\text{C/W}$ |

**Electrical Characteristics** at  $T_j=25^{\circ}\text{C}$  unless otherwise specified

| Parameter                        | Symbol       | Min. | Typ. | Max. | Unit          | Test condition                                  |
|----------------------------------|--------------|------|------|------|---------------|-------------------------------------------------|
| Drain-source breakdown voltage   | $BV_{DSS}$   | 120  |      |      | V             | $V_{GS}=0\text{ V}, I_D=250\text{ }\mu\text{A}$ |
| Gate threshold voltage           | $V_{GS(th)}$ | 2.0  |      | 4.0  | V             | $V_{DS}=V_{GS}, I_D=250\text{ }\mu\text{A}$     |
| Drain-source on-state resistance | $R_{DS(ON)}$ |      | 3.0  | 3.5  | m $\Omega$    | $V_{GS}=10\text{ V}, I_D=50\text{ A}$           |
| Gate-source leakage current      | $I_{GSS}$    |      |      | 100  | nA            | $V_{GS}=20\text{ V}$                            |
| Drain-source leakage current     | $I_{DSS}$    |      |      | 1    | $\mu\text{A}$ | $V_{DS}=120\text{ V}, V_{GS}=0\text{ V}$        |
| Gate resistance                  | $R_G$        |      | 4.9  |      | $\Omega$      | $f=1\text{ MHz}$ , Open drain                   |

### Dynamic Characteristics

| Parameter                    | Symbol       | Min. | Typ.  | Max. | Unit | Test condition                                                                             |
|------------------------------|--------------|------|-------|------|------|--------------------------------------------------------------------------------------------|
| Input capacitance            | $C_{iss}$    |      | 10051 |      | pF   | $V_{GS}=0\text{ V}$ ,<br>$V_{DS}=25\text{ V}$ ,<br>$f=100\text{ kHz}$                      |
| Output capacitance           | $C_{oss}$    |      | 4370  |      | pF   |                                                                                            |
| Reverse transfer capacitance | $C_{rss}$    |      | 415   |      | pF   |                                                                                            |
| Turn-on delay time           | $t_{d(on)}$  |      | 16.6  |      | ns   | $V_{GS}=10\text{ V}$ ,<br>$V_{DS}=60\text{ V}$ ,<br>$R_G=2\ \Omega$ ,<br>$I_D=60\text{ A}$ |
| Rise time                    | $t_r$        |      | 15.1  |      | ns   |                                                                                            |
| Turn-off delay time          | $t_{d(off)}$ |      | 104   |      | ns   |                                                                                            |
| Fall time                    | $t_f$        |      | 31.7  |      | ns   |                                                                                            |

### Gate Charge Characteristics

| Parameter            | Symbol        | Min. | Typ.  | Max. | Unit | Test condition                                                        |
|----------------------|---------------|------|-------|------|------|-----------------------------------------------------------------------|
| Total gate charge    | $Q_g$         |      | 146.6 |      | nC   | $V_{GS}=10\text{ V}$ ,<br>$V_{DS}=60\text{ V}$ ,<br>$I_D=60\text{ A}$ |
| Gate-source charge   | $Q_{gs}$      |      | 41.3  |      | nC   |                                                                       |
| Gate-drain charge    | $Q_{gd}$      |      | 41.8  |      | nC   |                                                                       |
| Gate plateau voltage | $V_{plateau}$ |      | 5.2   |      | V    |                                                                       |

### Body Diode Characteristics

| Parameter                     | Symbol    | Min. | Typ. | Max. | Unit | Test condition                                                                 |
|-------------------------------|-----------|------|------|------|------|--------------------------------------------------------------------------------|
| Diode forward voltage         | $V_{SD}$  |      |      | 1.3  | V    | $I_S=20\text{ A}$ ,<br>$V_{GS}=0\text{ V}$                                     |
| Reverse recovery time         | $t_{rr}$  |      | 116  |      | ns   | $V_R=60\text{ V}$ ,<br>$I_S=60\text{ A}$ ,<br>$di/dt=100\text{ A}/\mu\text{s}$ |
| Reverse recovery charge       | $Q_{rr}$  |      | 410  |      | nC   |                                                                                |
| Peak reverse recovery current | $I_{rrm}$ |      | 5.8  |      | A    |                                                                                |

### Note

- 1) Calculated continuous current based on maximum allowable junction temperature.
- 2) Repetitive rating; pulse width limited by max. junction temperature.
- 3)  $P_d$  is based on max. junction temperature, using junction-case thermal resistance.
- 4) The value of  $R_{\theta JA}$  is measured with the device mounted on 1 in<sup>2</sup> FR-4 board with 2oz. Copper, in a still air environment with  $T_a=25\text{ }^{\circ}\text{C}$ .
- 5)  $V_{DD}=50\text{ V}$ ,  $V_{GS}=10\text{ V}$ ,  $L=0.3\text{ mH}$ , starting  $T_j=25\text{ }^{\circ}\text{C}$ .

## Electrical Characteristics Diagrams

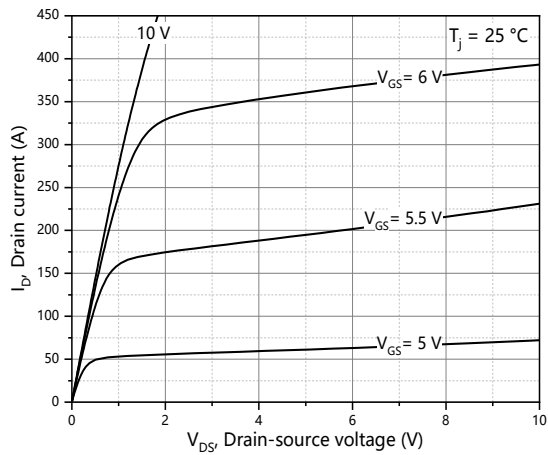


Figure 1. Typ. output characteristics

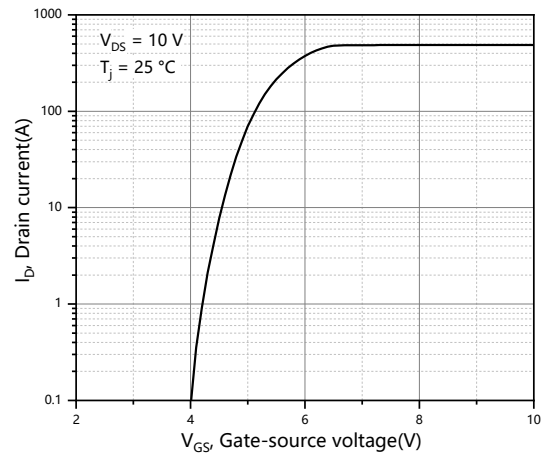


Figure 2. Typ. transfer characteristics

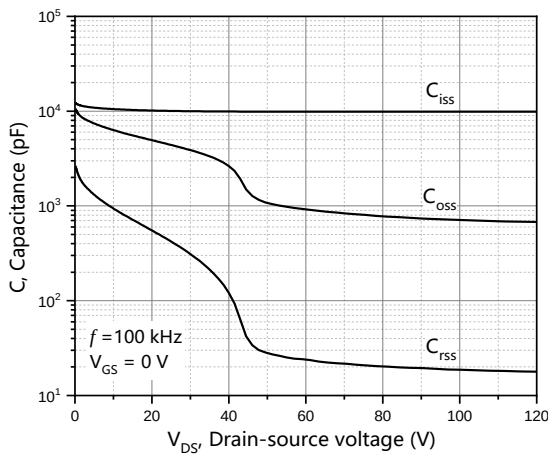


Figure 3. Typ. capacitances

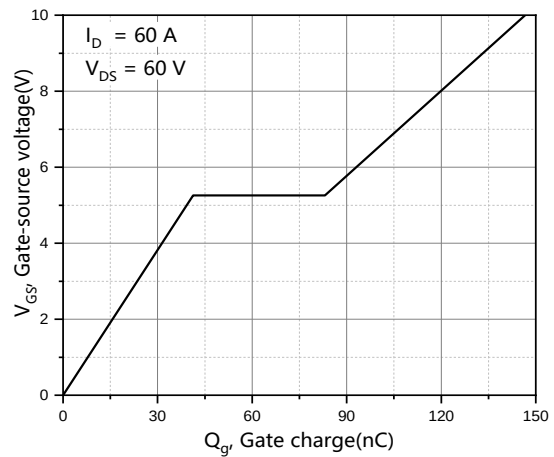


Figure 4. Typ. gate charge

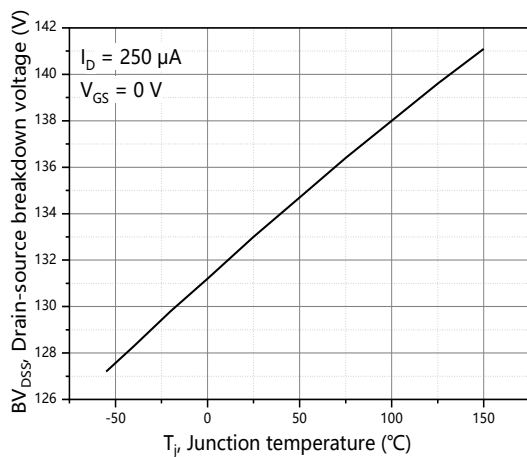


Figure 5. Drain-source breakdown voltage

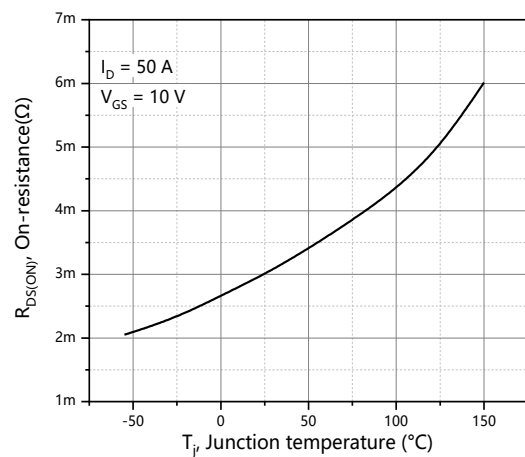
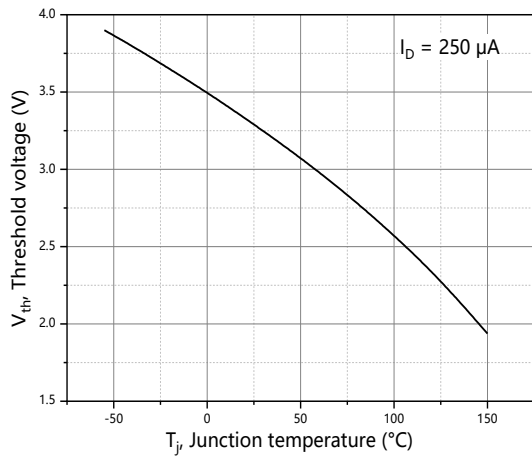
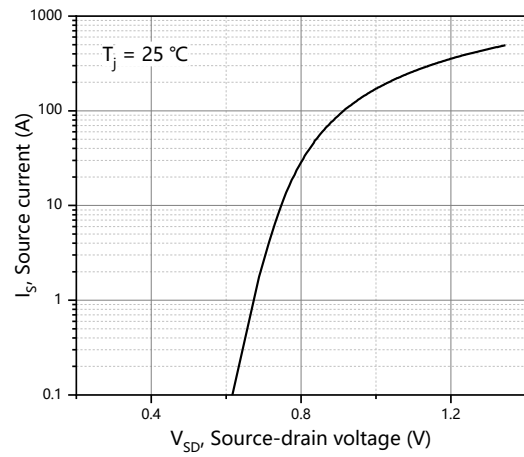


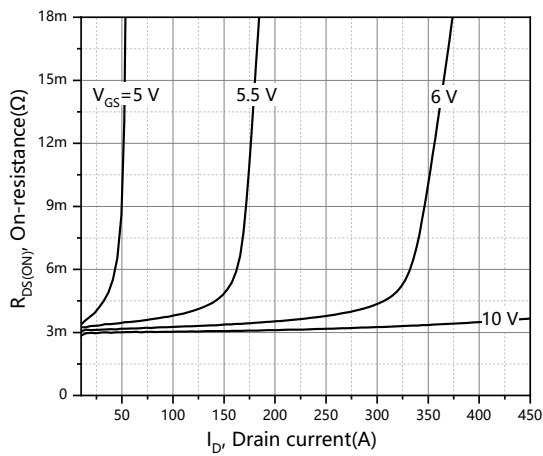
Figure 6. Drain-source on-state resistance



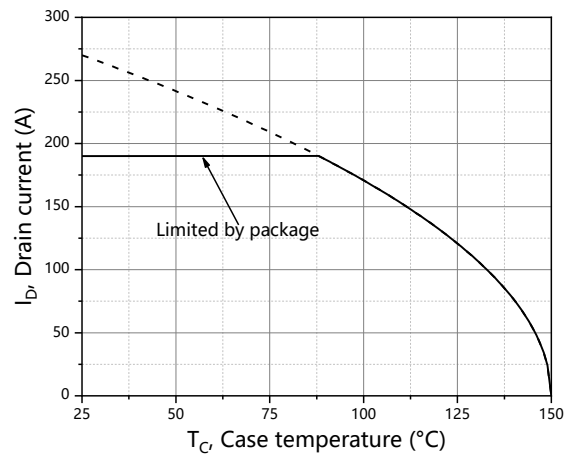
**Figure 7. Threshold voltage**



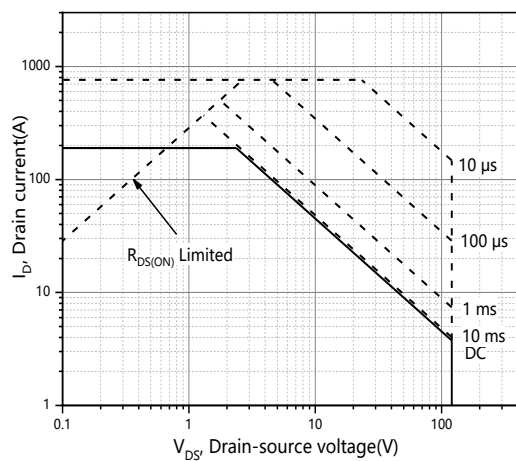
**Figure 8. Forward characteristic of body diode**



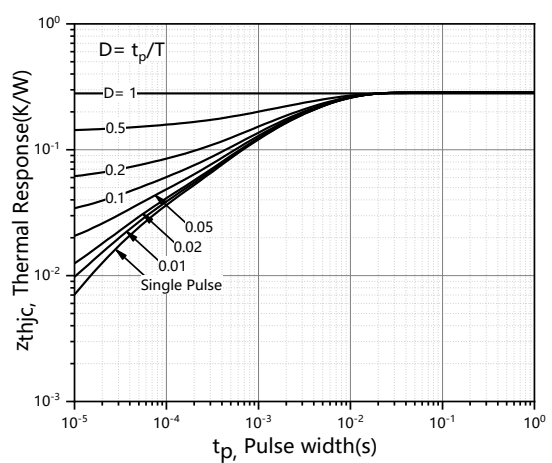
**Figure 9. Drain-source on-state resistance**



**Figure 10. Drain current**

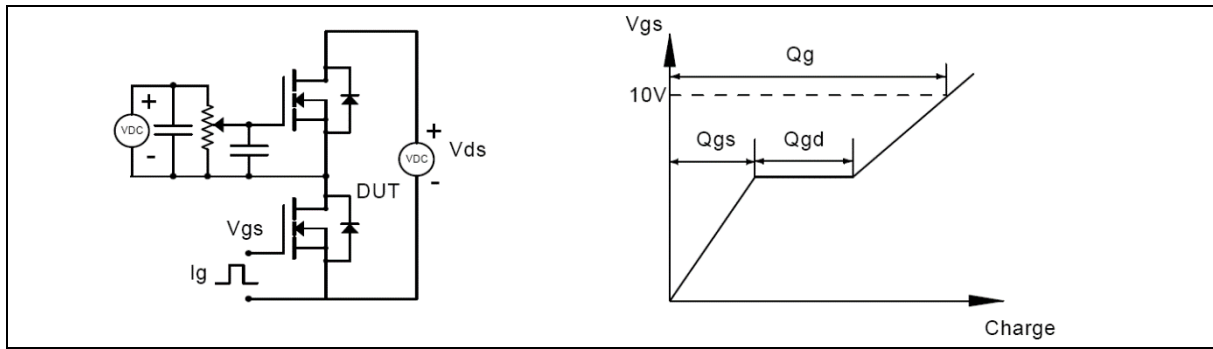


**Figure 11. Safe operation area  $T_C=25\text{ }^{\circ}\text{C}$**

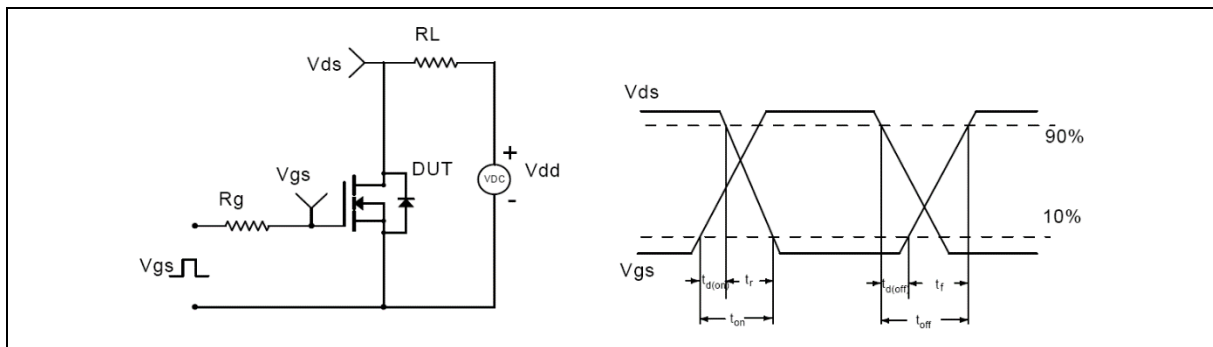


**Figure 12. Max. transient thermal impedance**

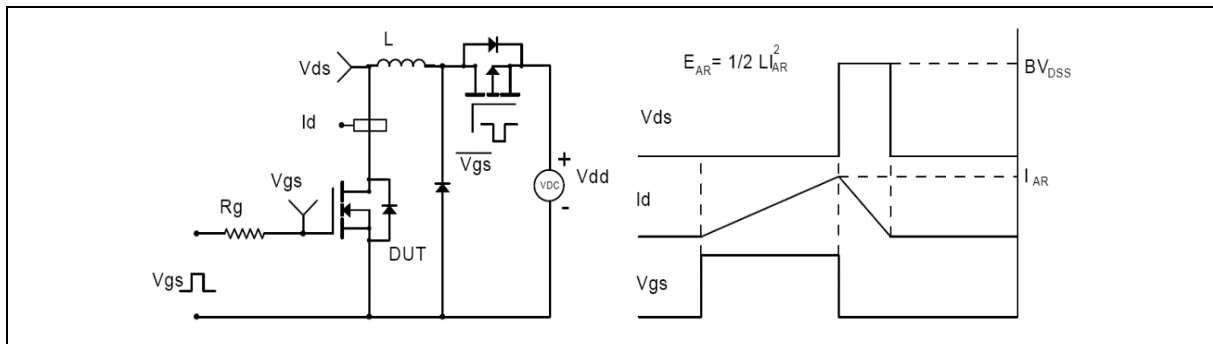
## Test circuits and waveforms



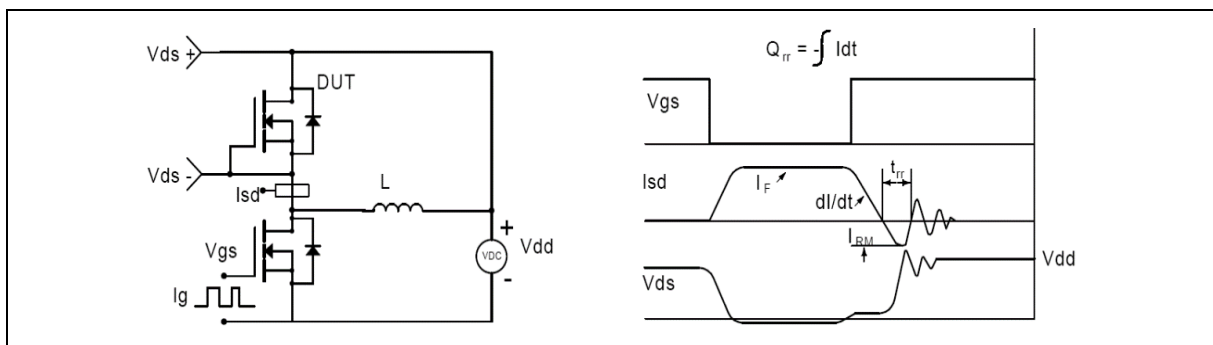
**Figure 1. Gate charge test circuit & waveform**



**Figure 2. Switching time test circuit & waveforms**

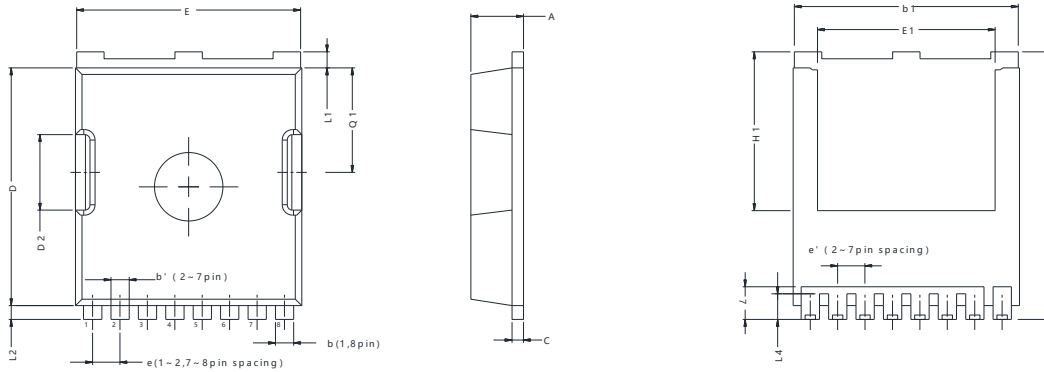


**Figure 3. Unclamped inductive switching (UIS) test circuit & waveforms**



**Figure 4. Diode reverse recovery test circuit & waveforms**

## Package Information



| Symbol | mm        |       |       |
|--------|-----------|-------|-------|
|        | Min       | Nom   | Max   |
| A      | 2.15      | 2.30  | 2.45  |
| b      | 0.75      | 0.75  | 0.85  |
| b'     | 0.70      | 0.70  | 0.80  |
| b1     | 9.65      | 9.80  | 9.95  |
| C      | 0.45      | 0.50  | 0.60  |
| D      | 10.18     | 10.38 | 10.58 |
| D2     | 3.15      | 3.30  | 3.45  |
| E      | 9.70      | 9.90  | 10.10 |
| E1     | 7.95      | 8.10  | 8.25  |
| e      | BSC 1.225 |       |       |
| e'     | BSC 1.20  |       |       |
| Q1     | 4.40      | 4.55  | 4.70  |
| H      | 11.48     | 11.68 | 11.88 |
| H1     | 6.80      | 6.95  | 7.10  |
| L      | 1.60      | 1.80  | 2.00  |
| L1     | 0.50      | 0.70  | 0.90  |
| L2     | 0.48      | 0.60  | 0.72  |
| L4     | 1.00      | 1.15  | 1.30  |

Version 1: TOLL-P package outline dimension

## Ordering Information

| Package Type | Units/ Reel | Reels/ Inner Box | Units/ Inner Box | Inner Boxes/ Carton Box | Units/ Carton Box |
|--------------|-------------|------------------|------------------|-------------------------|-------------------|
| TOLL-P       | 1200        | 1                | 1200             | 5                       | 6000              |

## Product Information

| Product     | Package | Pb Free | RoHS | Halogen Free |
|-------------|---------|---------|------|--------------|
| SFG12R03TNF | TOLL    | yes     | yes  | yes          |

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